

Runtime randomization and perturbation for virtual machines.

JAVIER CABRERA ARTEAGA

Licentiate Thesis in [Research Subject - as it is in your ISP]
School of Information and Communication Technology
KTH Royal Institute of Technology
Stockholm, Sweden [2022]

TRITA-ICT XXXX:XX ISBN XXX-XXX-XXXX-X KTH School of Information and Communication Technology SE-164 40 Kista SWEDEN

Akademisk avhandling som med tillstånd av Kungl Tekniska högskolan framlägges till offentlig granskning för avläggande av licentiatexamen i [ämne/subject] [veckodag/weekday] den [dag/day] [månad/month] [år/2022] klockan [tid/time] i [sal/hall], Electrum, Kungl Tekniska högskolan, Kistagången 16, Kista.

© Javier Cabrera Arteaga, [month] [2022]

Tryck: Universitetsservice US AB

Abstract

Write your abstract here... $\textbf{Keywords:} \ \, \textbf{Keyword1}, \, \textbf{keyword2}, \, \dots$

Sammanfattning

Write your Swedish summary (popular description) here... $\bf Keywords : Keyword1, \, keyword2, \, ...$

Acknowledgements

Write your professional acknowledgements here...

Acknowledgements are used to thank all persons who have helped in carrying out the research and to the research organizations/institutions and/or companies for funding the research.

 $Name\ Surname,$ Place, Date

Contents

C	onter	nts	vi		
Li	st of	Figures	viii		
Li	st of	Tables	ix		
Li	st of	Acronyms	xi		
1	Intr	roduction	1		
	1.1	Motivation	1 1 1 1		
2	Background and State of the art				
	2.1	CROW	3		
3	Met	thodology	5		
	3.1 3.2	Corpora	5		
	3.3 3.4	Assembly?	7 9		
	3.5	tion times on Edge-Cloud platforms?	11 13		
4	Res	ults	15		
	4.1	RQ1. To what extent can we generate program variants for Web-Assembly?	15 17		
	4.3	- · · · · · · · · · · · · · · · · · · ·			
	4.4	Answer to RQ2	21		

	CON	TENTS	vii
	4.5	RQ3. To what extent the artificial variants exhibit different execu-	
		tion times on Edge-Cloud platforms?	21
	4.6	Answer to RQ3	22
	4.7	Conclusions	23
5	Con	clusions	25

List of Figures

2.1	CROW workflow to generate program variants. CROW takes C/C++ source codes or LLVM bitcodes to look for code blocks that can be replaced by semantically equivalent code and generates program variants by combining them	3
3.1	The program variants generation for RQ1	8
3.2	Dynamic analysis for RQ2	10
3.3	Multivariant binary creation and workflow for RQ3	
4.1	Pairwise comparison of programs' population traces in logarithmic scale. Each vertical group of blue dots represents a programs' population. Each dot represents a comparison between two program execution traces according to Metric 2	19
4.2	Execution time distributions for Hilber_curve program and its variants. Baseline execution time mean is highlighted with the magenta	
	horizontal line	20
4.3	Execution time distributions. Each subplot represents the quantile- quantile plot of the two distributions, original and multivariant binary.	
		22

List of Tables

3.1	Corpora description. The table is composed by the name of the cor-	
	pus, the number of modules, the number of programs, the number of	
	functions, the lines of code range and the location of the corpus. \dots	7
4.1	General diversification results. The table is composed by the name of the corpus, the number of functions, the number of successfully diversified functions, the number of non-diversified functions and the cumulative	17
	number of variants	- 10

List of Acronyms

Wasm WebAssembly

DTW Dynamic Time Warping